

Accuracy Characteristics for Final Delivery Scenario Hours 1400-1900 Interfacility

1 Introduction

This document contains scenario characteristics for hours 1400 to 1900 GMT recorded on May 26, 1999 at Memphis ARTCC and cover either the ZME or ZID airspace. Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, flight plan adherence, interfacility traffic flow and deviations in weather forecasts. Definitions of the provided scenario characteristics are provided in Reference[1].

2 Reference

[1] Paglione,M., Oaks,R., Ryan,Dr. H., Summerill,J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

3 Center Airspace

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZME Center using the May 20, 1999 ACES chart cycle. Information gathered from running URET PRE, accessing the ZME Center Internet site and local knowledge.

Metric	Definitions	Count
Center Area	Approximate Square Miles	120000
Airports	From URET DU Adaptation List	778
Sectors	From URET DU Adaptation List	110
SAA	Special Activities Airspace	57
APDIA	Automated Problem Detection Inhibited Area	20
SID	Standard Instrument Departure	11
STAR	Standard Arrival Route	10
PAR	Preferential Arrival Route	594
PDR	Preferential Departure Route	346
PDAR	Preferential Departure Arrival Route	124

4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

Table 1: Count of Current Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	139	86
$5 \leq d < 10$	197	108
$10 \leq d < 15$	226	126
$15 \leq d < 23$	472	285
$23 \leq d < 30$	435	263
Total	1469	868

Table 2: Count of Trial Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	139	77
$5 \leq d < 10$	197	102
$10 \leq d < 15$	226	120
$15 \leq d < 24$	537	304
$24 \leq d < 30$	370	208
Total	1469	811

4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

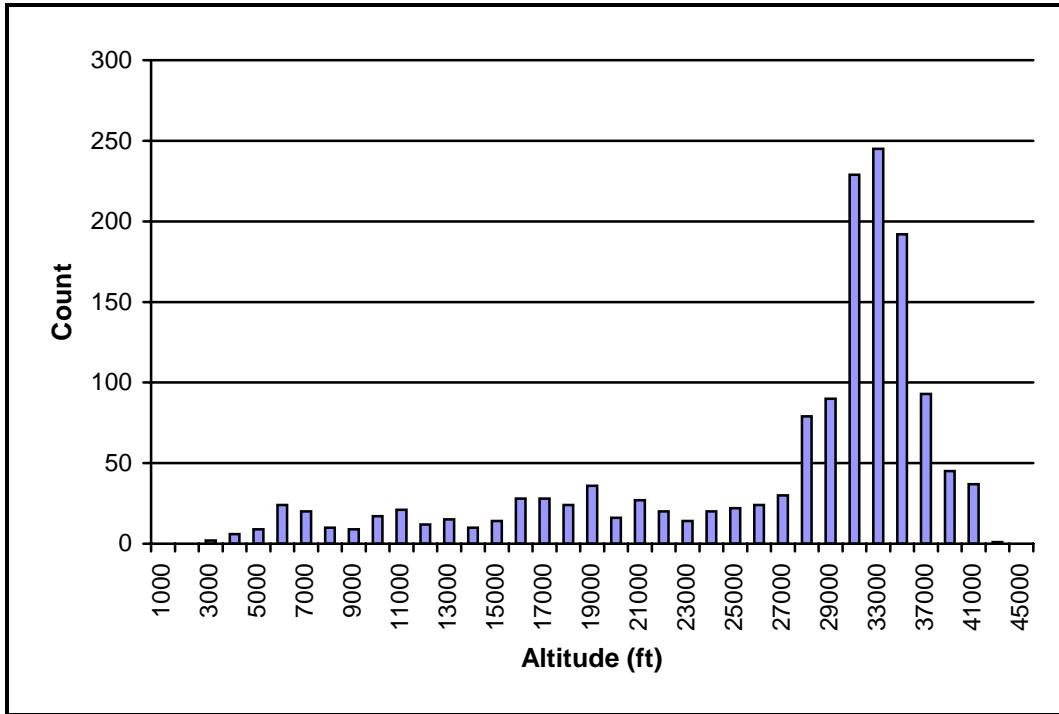


Figure 1: Aircraft to Aircraft Encounters by Altitude

4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 3: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	124	116	59	30	329
Descend-Descend	49	12	8	11	80
Climb-Climb	40	11	2	8	61
Cruise-Climb	173	87	84	103	447
Cruise-Descend	142	96	72	130	440
Climb-Descend	31	14	10	34	89
Unknown	18	3	2	0	23
Total	577	339	237	316	1469

5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

Table 4: Count of Current Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts ¹	2283	1942
$d = 0^2$	41	36
$0 < d < 7$	881	699
$7 \leq d < 9$	219	171
$9 \leq d < 11$	198	143
$11 \leq d < 16$	519	413
$16 \leq d < 30$	1793	1397
Total	5934	4801

Table 5: Count of Trial Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts ³	2283	1898
$d = 0^4$	41	35
$0 < d < 8$	999	772
$8 \leq d < 11$	299	222
$11 \leq d < 13$	192	148
$13 \leq d < 19$	712	571
$19 \leq d < 30$	1408	1038
Total	5934	4684

¹ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

² This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

³ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

⁴ This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

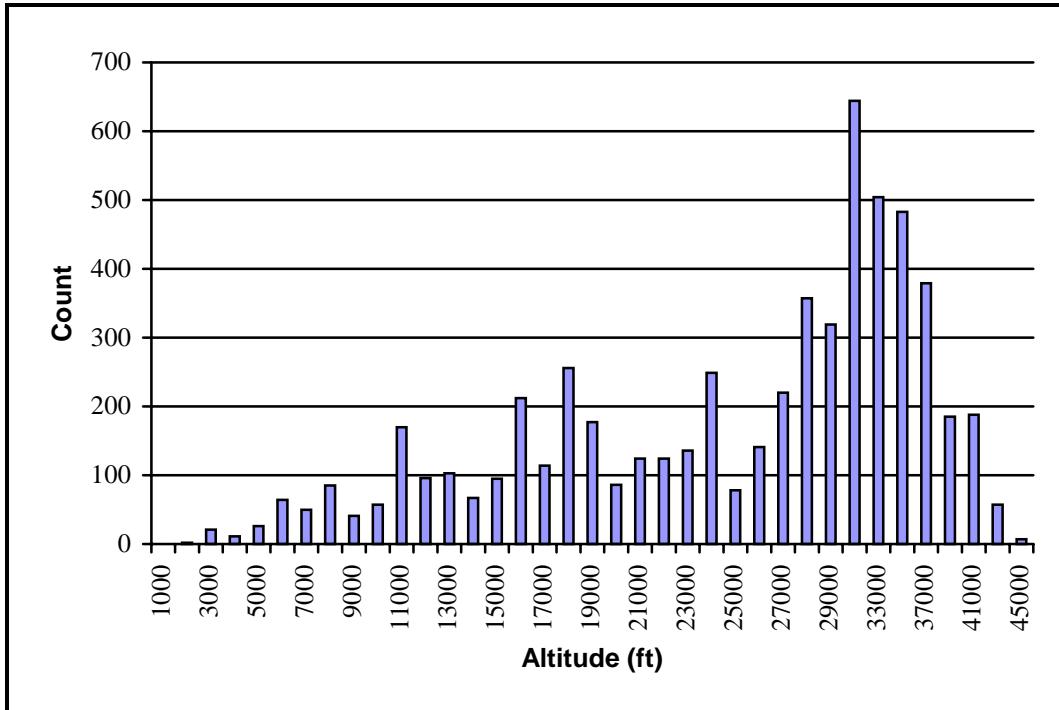


Figure 2: Airspace to Airspace Encounters by Altitude

5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

Table 6: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	11	65	128	204
Cruise	178	550	776	1504
Descend	16	59	69	144
Total	205	674	973	1852

Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	154	0	0	154
Cruise	0	0	0	0
Descend	25	0	0	25
Total	179	0	0	179

Table 8: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles

Vertical Phase	Count
Climb	53
Cruise	163
Descend	36
Total	252

6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

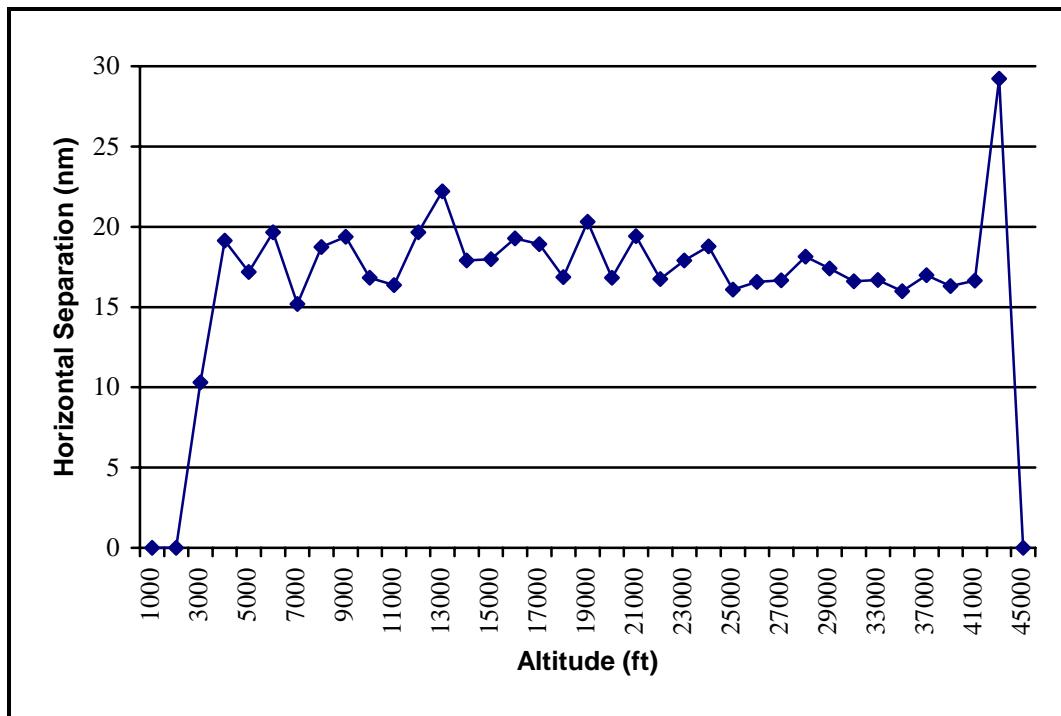


Figure 3: Average Horizontal Separation by Altitude for All Hours

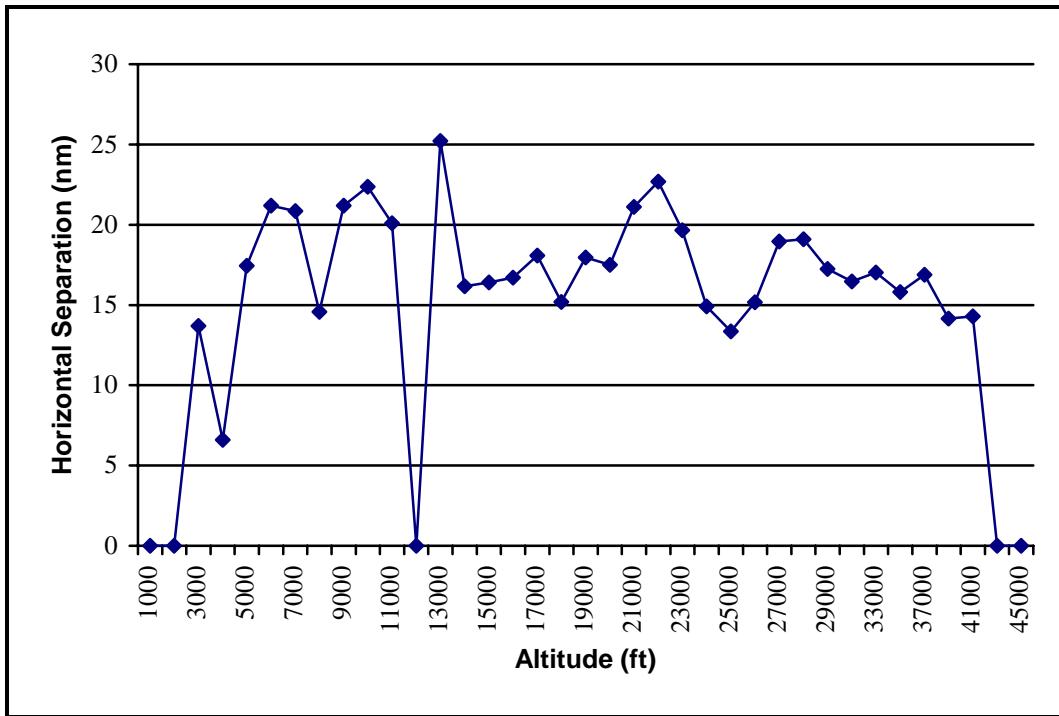


Figure 4: Average Horizontal Separation by Altitude for Hour 1

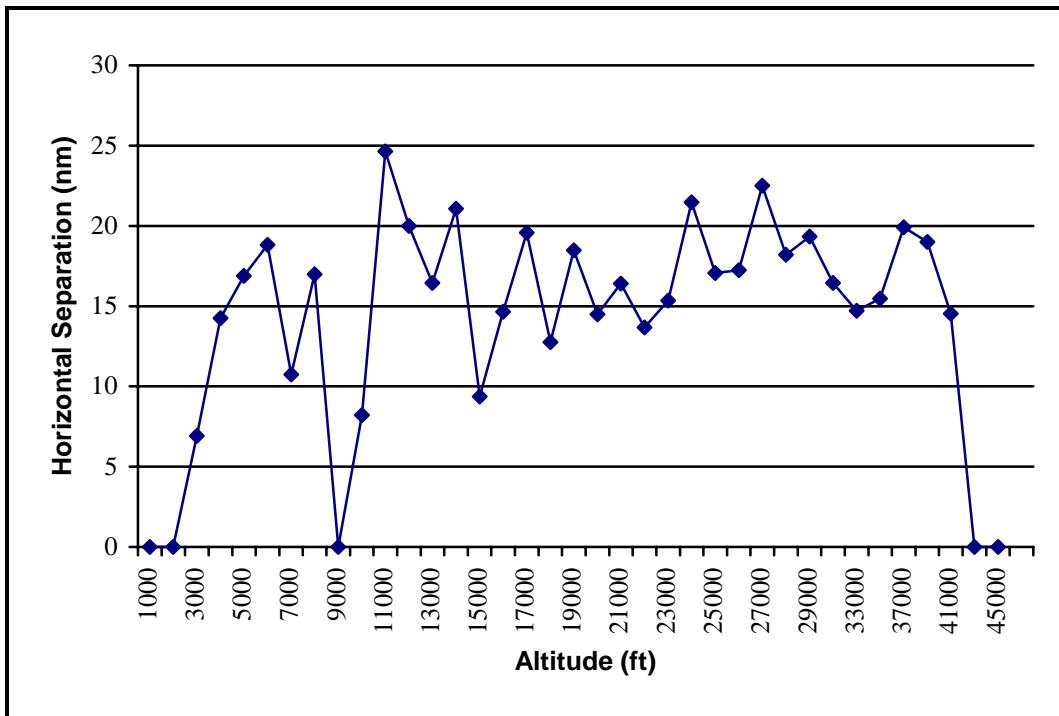


Figure 5: Average Horizontal Separation by Altitude for Hour 2

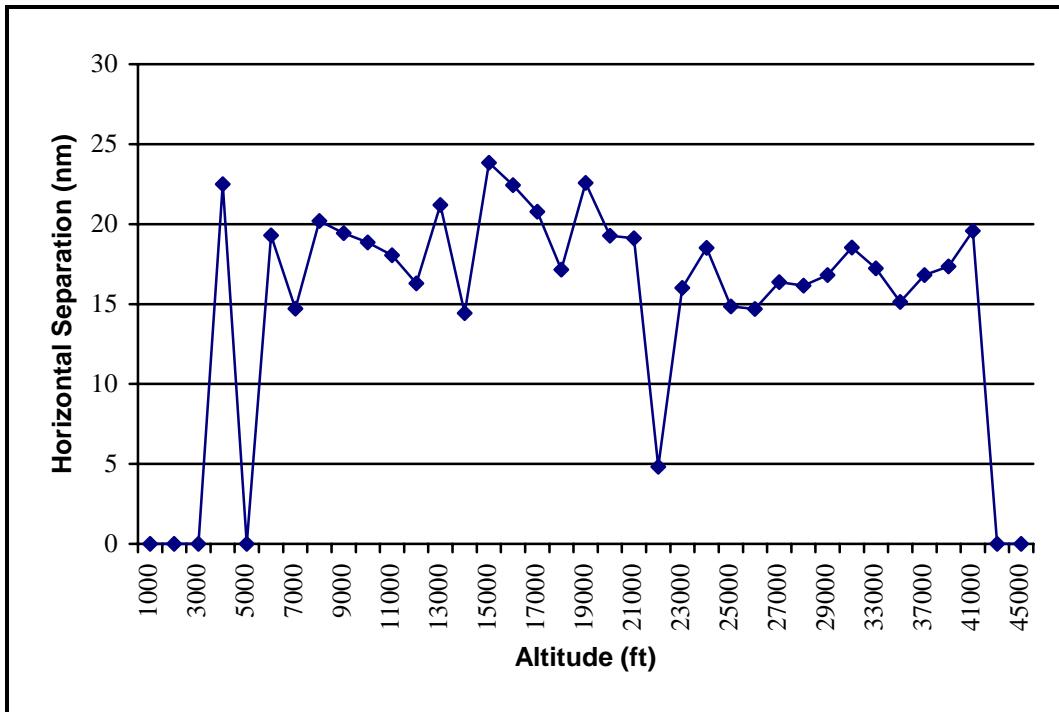


Figure 6: Average Horizontal Separation by Altitude for Hour 3

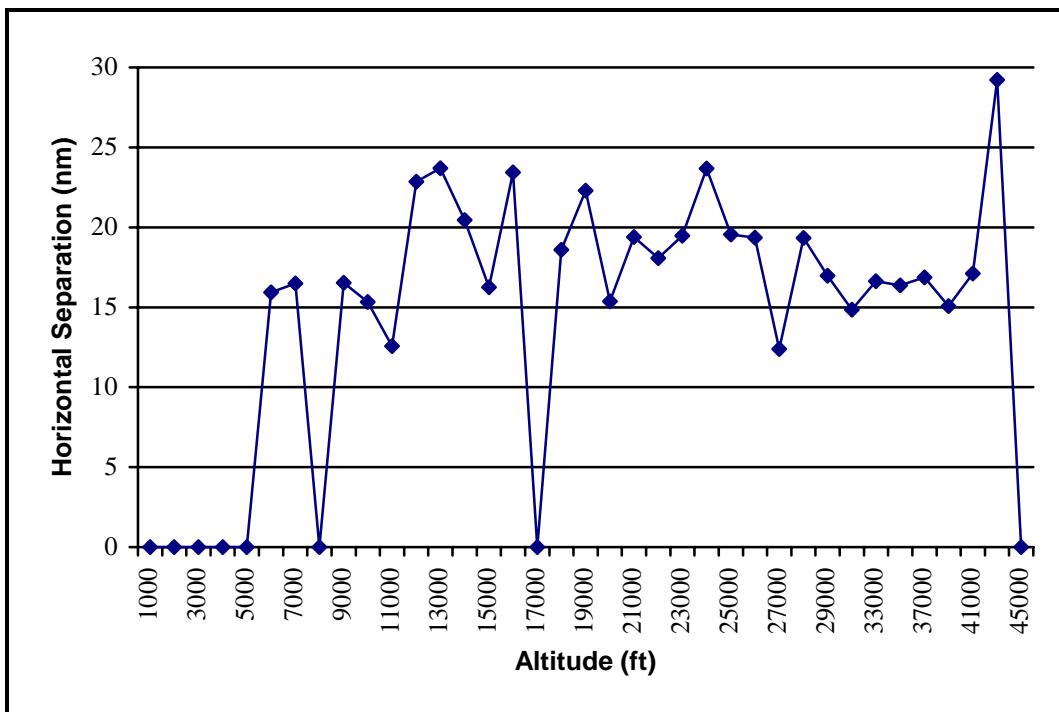


Figure 7: Average Horizontal Separation by Altitude for Hour 4

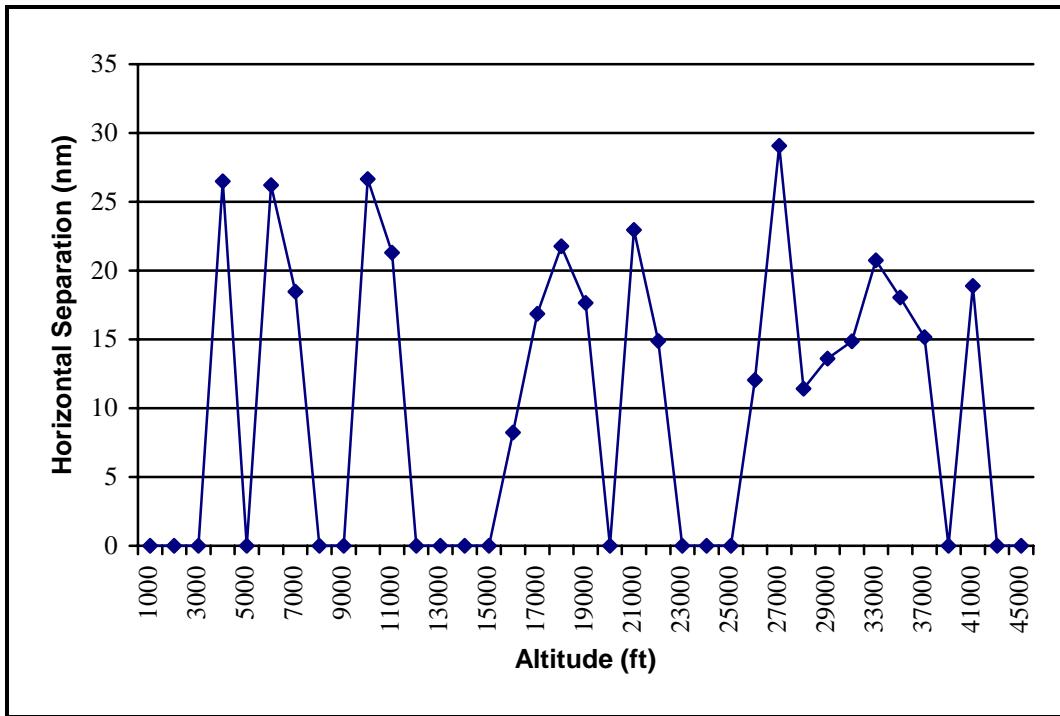


Figure 8: Average Horizontal Separation by Altitude for Hour 5

6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

Table 9: Statistics on Active Flights per Minute Increment

Count Average	Standard Deviation	Maximum Count	Minimum Count
184.863	74.825	275	0

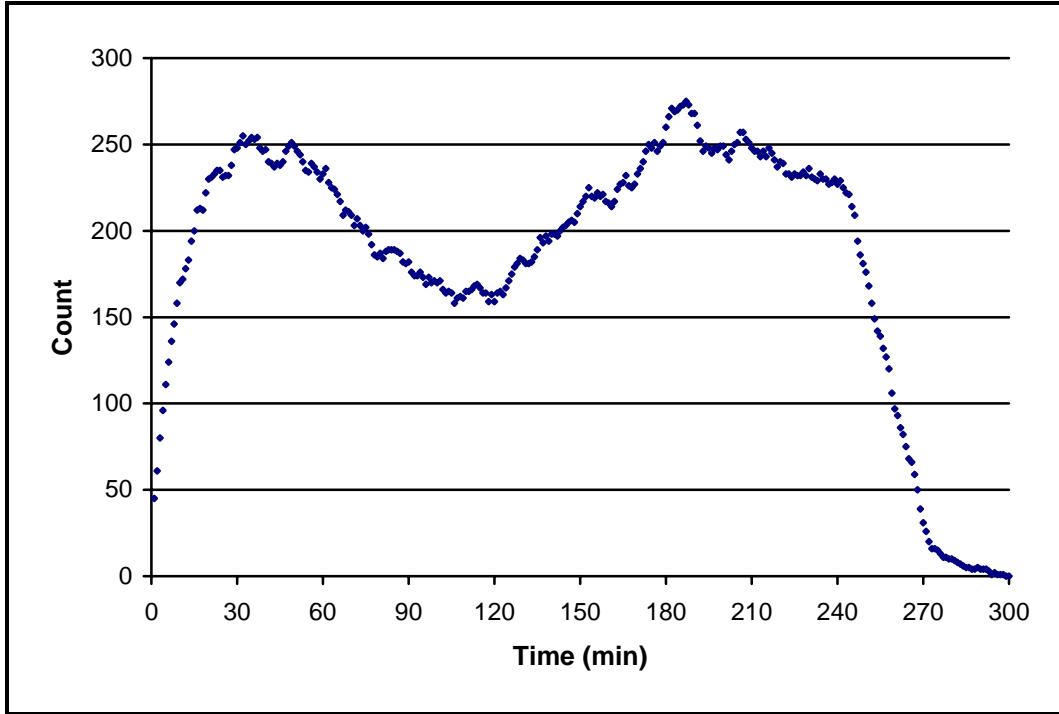


Figure 9: Count of Active Flights per Minute Increment

6.3 Flight Type and Sector Penetration

This section corresponds to Section 3.3.3 of Reference[1].

Table 10: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	2.003	2.131	1.930	2.440	2.249
Average Time in Center (sec)	1403.312	1170.758	1388.300	1774.426	1538.532
Average Time in Sector (sec)	673.371	533.529	691.762	717.181	668.759
Percentage by Flight Type	20.200	22.500	6.600	50.800	100.000

6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.

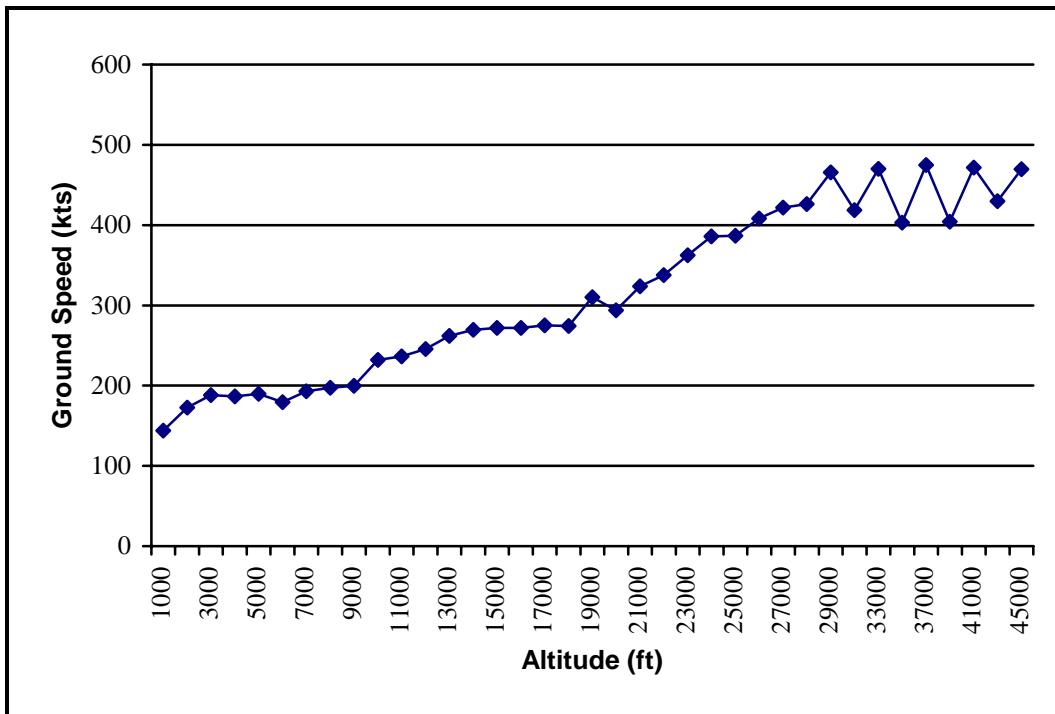


Figure 10: Average Ground Speed by Altitude for All Hours

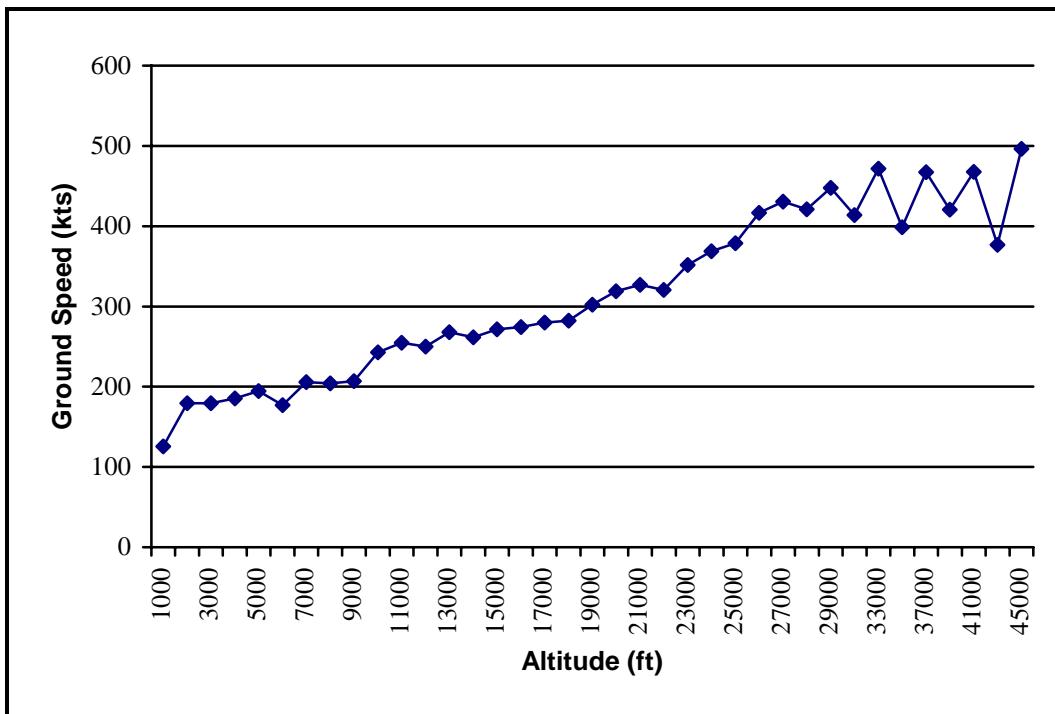


Figure 11: Average Ground Speed by Altitude for Hour 1

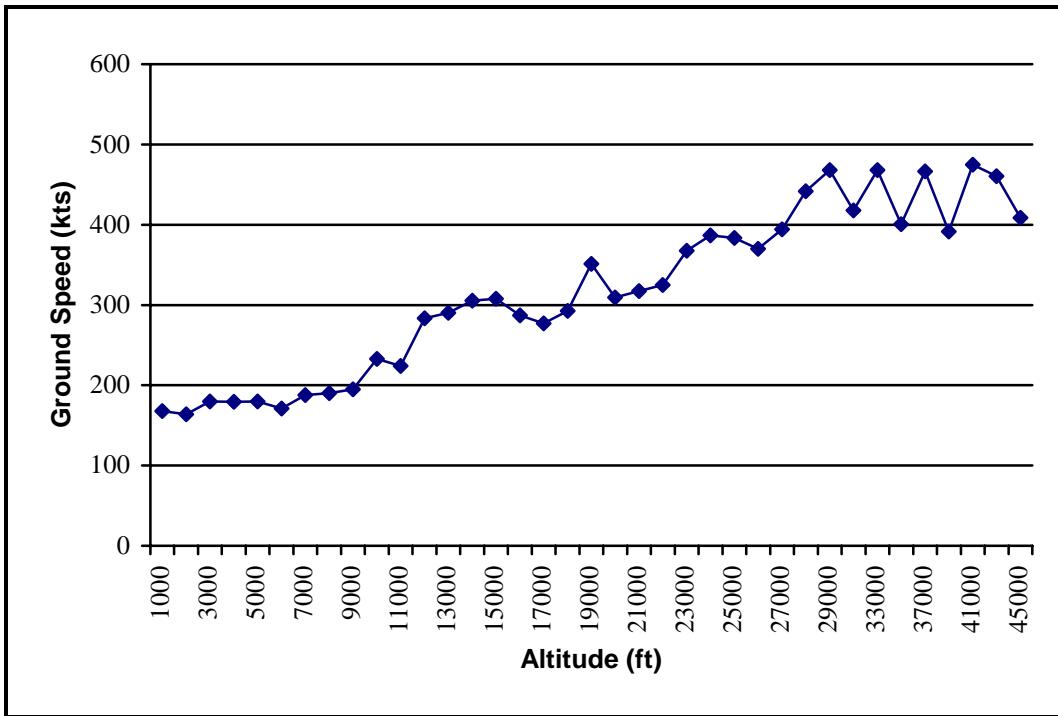


Figure 12: Average Ground Speed by Altitude for Hour 2

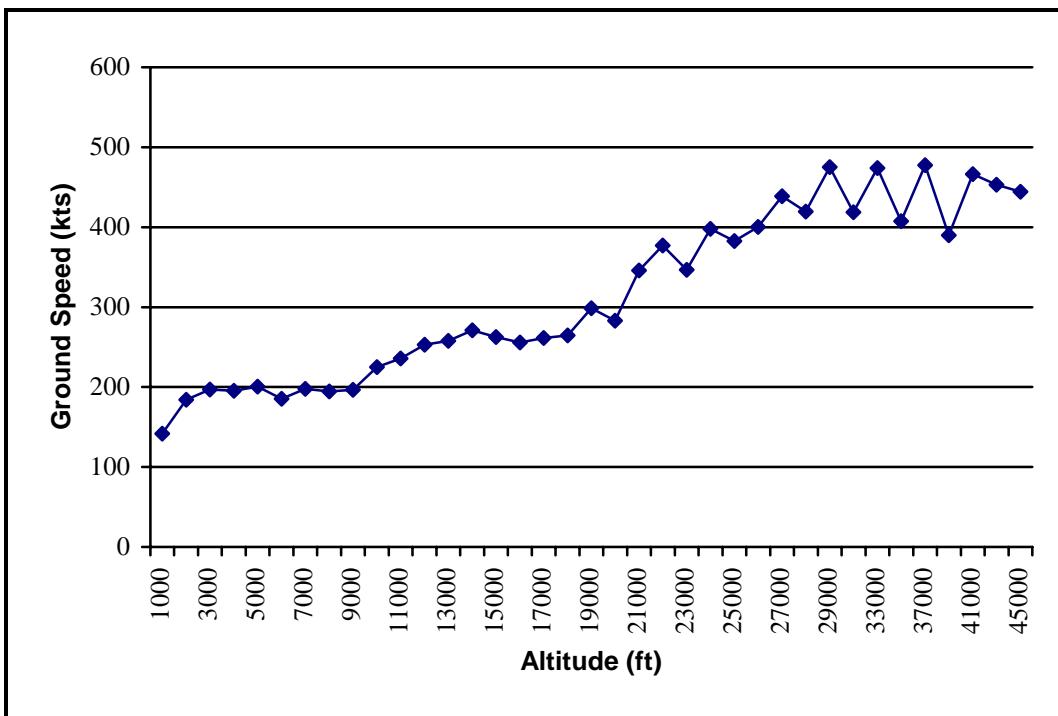


Figure 13: Average Ground Speed by Altitude for Hour 3

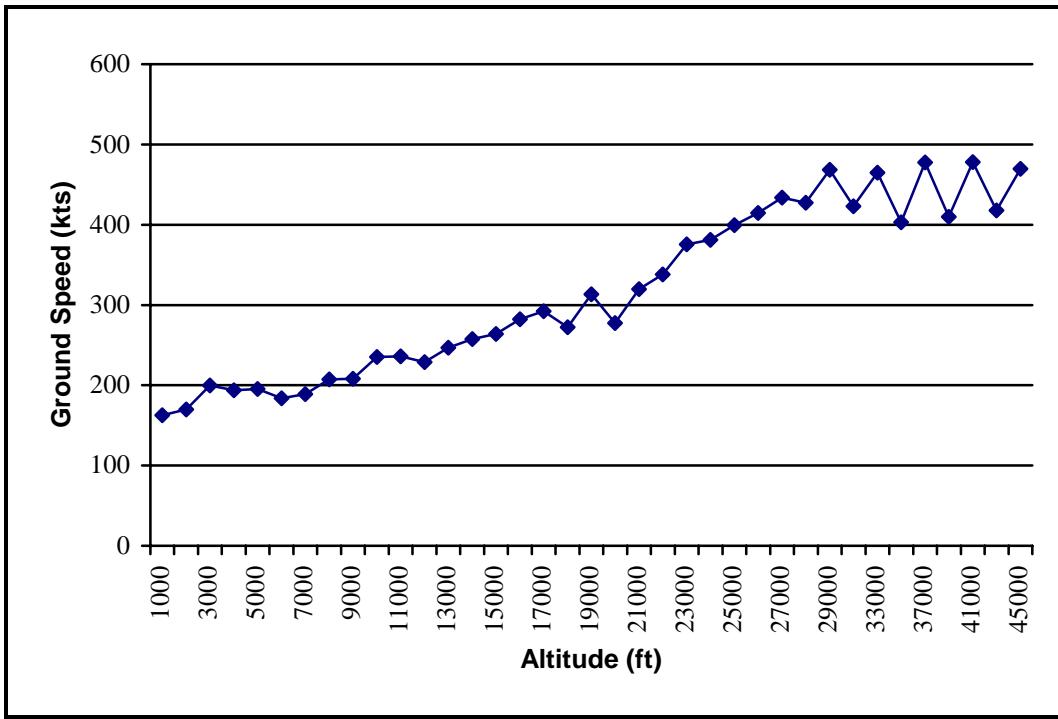


Figure 14: Average Ground Speed by Altitude for Hour 4

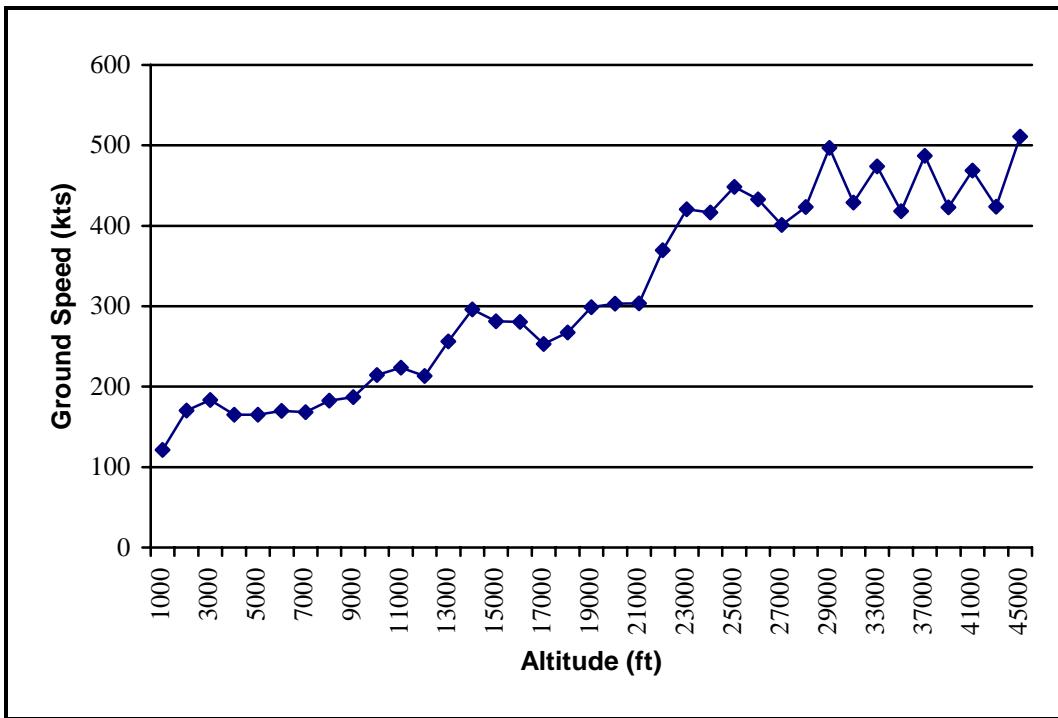


Figure 15: Average Ground Speed by Altitude for Hour 5

6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

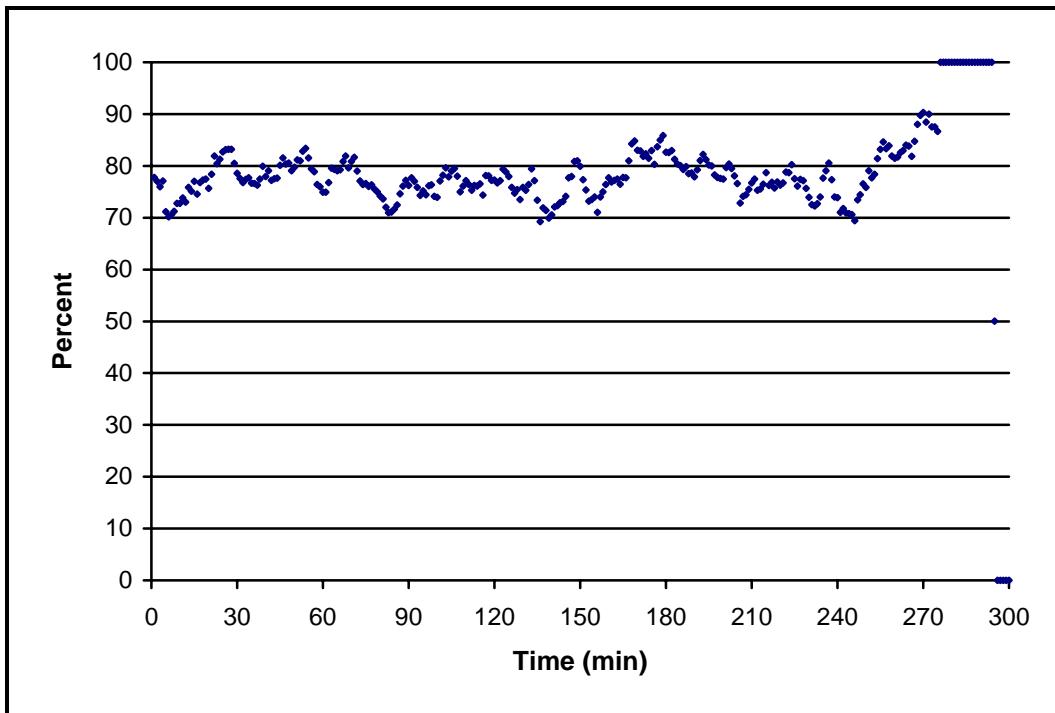


Figure 16: Percentage of Track Points in Center to APD Zone per Minute Increment

6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 11: Statistics on Interim Altitude Messages⁵

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
1053	2.838	1.136	8	1

6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1]

Table 12: Statistics on Amendment Messages per Flight⁶

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
755	1.983	1.250	10	1

⁵ Statistics on flights with interim altitude messages only

⁶ Statistics on flights with flight plan amendments only

6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

Table 13: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	7680	1722	9402
DES	8718	1844	10562
LEV	3347	1981	5328
Total	19745	5547	25292

Table 14: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	30.365	6.808	37.174
DES	34.469	7.291	41.760
LEV	13.233	7.833	21.066
Margin (%)	78.068	21.932	100.000

7 Aircraft Distributions

This section provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

Table 15: Count by Aircraft Type

Aircraft Type	Count	Percentage of Total
J	1050	68.807
P	212	13.893
T	272	17.824
Unknown	2	0.131
Total	1536	100.655

7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

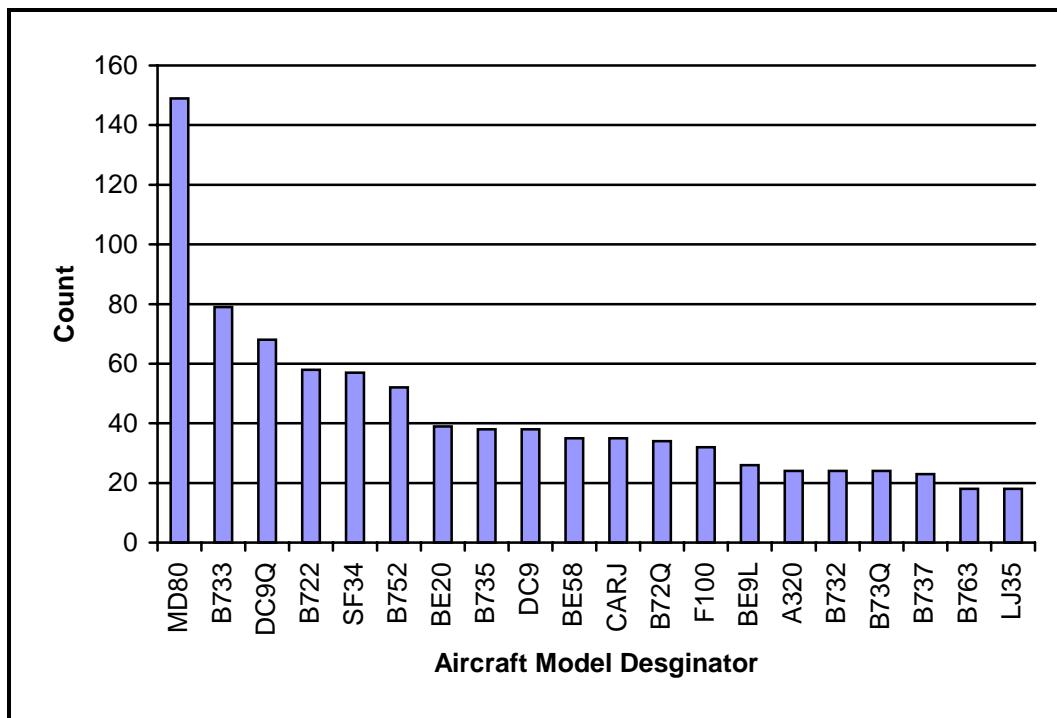


Figure 17: Count of Top Twenty Aircraft Models

7.3 Navigational Equipage

This section corresponds to Section 3.4.3 of Reference[1].

Table 16: Count by Aircraft Navigational Equipage Type

Nav. Equip. Designator	Count	Percentage of total
A	446	29.036
I	382	24.870
G	276	17.969
E	176	11.458
F	155	10.091
R	56	3.646
U	18	1.172
P	14	0.911
W	13	0.846
Total	1536	100.000

7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

Table 17: Count by Carrier Type

Category	Count	Percentage of Total
Commercial	962	62.630
General Aviation	507	33.008
Other ⁷	67	4.362
Total	1536	100.000

⁷ Includes military and aircraft with unrecognized designators

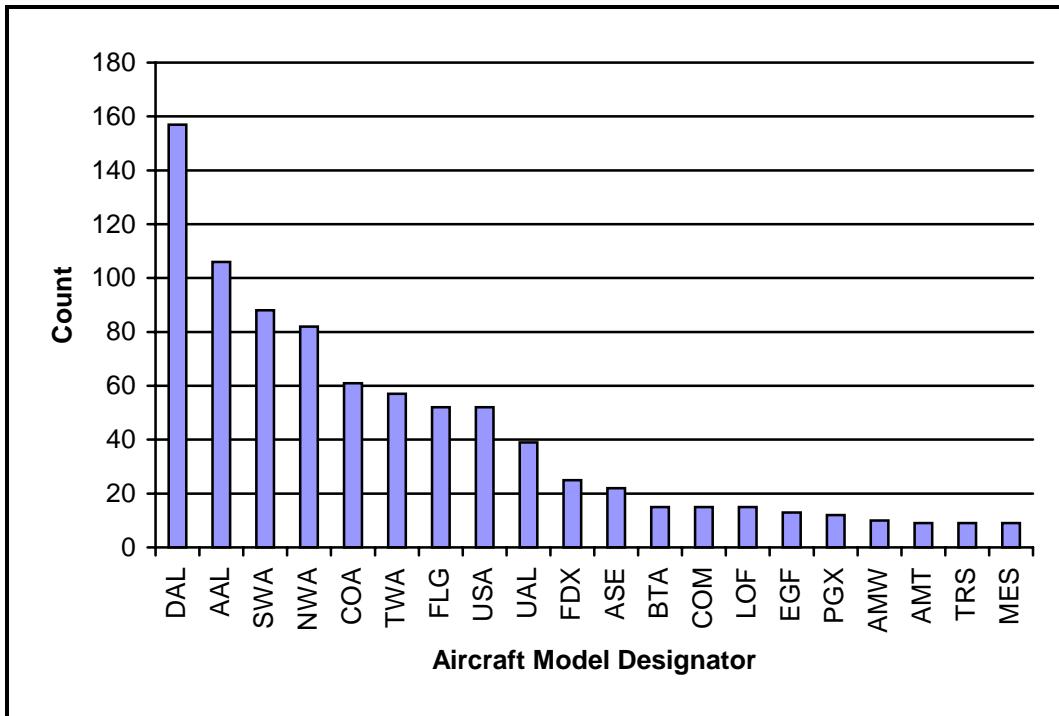


Figure 18: Count by Top Twenty Air Carriers

8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

Table 18: Statistics on Lateral Flight Plan Adherence by Altitude⁸

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	41	41	11	17.206	5.857
18000	37	51	13	23.143	9.451
33000	91	117	13	27.025	13.992
45000	47	56	14	25.387	6.345
Total	216				

8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

Table 19: Statistics on Vertical Flight Plan Adherence by Altitude⁹

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	638	43000	308	4072.968	3526.345
45000	268	19000	517	4365.980	2978.039
Total	906				

⁸ Statistics determined on tracks out of lateral adherence only.

⁹ Statistics were determined on tracks out of vertical adherence only.

9 Interfacility Traffic Flow

This section corresponds to Section 3.6 of Reference[1]. Table 20 duplicates Table 3.6-1 in reference and provides definitions for cells in Tables 21 and 22.

Table 20: Matrix of Traffic Sources in Scenario

Input - Flights into ZME		Output - Flights from ZME	
Starts in ZID		Ends in ZID	
Starts in ZME		Ends in ZME	
Starts in Other Center		Ends in Other Center	

Table 21: Statistics on Flights to ZME Airspace per minute

Input Flights	Average	Standard Deviation	Maximum Count	Minimum Count
From ZID	28.197	13.319	50	0
From ZME	56.483	29.654	132	0
From Other	100.183	48.301	169	0

Table 22: Statistics on Flights from ZME Airspace per minute

Output Flights	Average	Standard Deviation	Maximum Count	Minimum Count
To ZID	23.347	10.389	36	0
To ZME	61.720	29.062	127	0
To Other	99.797	48.651	166	0

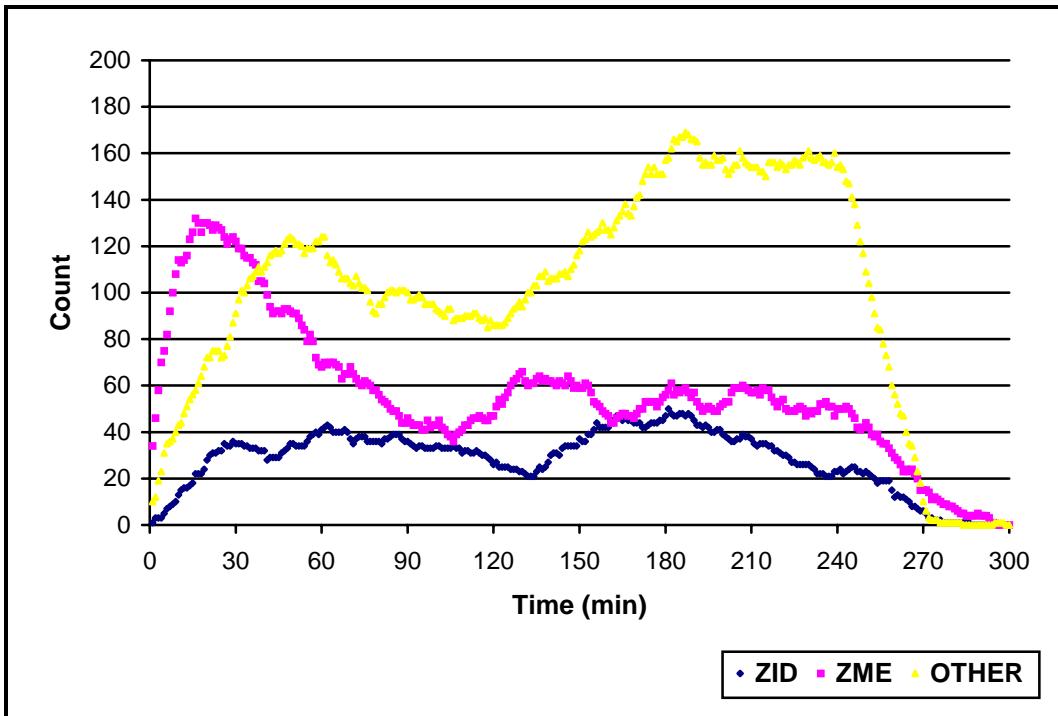


Figure 19: Flights into ZME from Legend Centers

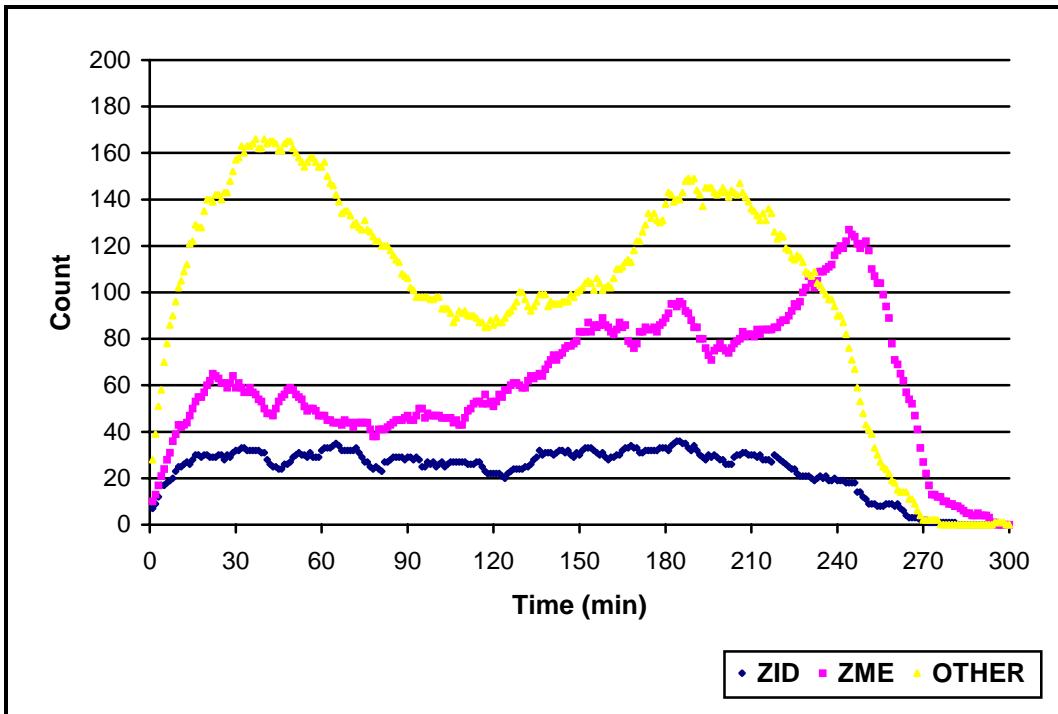


Figure 20: Flights from ZME to Legend Centers

10 Weather Variations

This section corresponds to Section 3.7 of Reference[1]. See the following document,

Kelly, Betty A., *User Request Evaluation Tool Core Capability Limited Deployment Accuracy Scenario Weather Forecast Deviation Study*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

Table 23: Statistics on Aircraft Encounters by Altitude Interval for All Hours

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	2	10.297	4.794
4000	6	19.146	7.470
5000	9	17.190	8.723
6000	24	19.650	7.812
7000	20	15.188	7.846
8000	10	18.743	6.257
9000	9	19.373	7.902
10000	17	16.814	6.879
11000	21	16.367	7.976
12000	12	19.645	8.488
13000	15	22.198	5.604
14000	10	17.893	6.244
15000	14	17.985	8.095
16000	28	19.268	8.252
17000	28	18.925	6.337
18000	24	16.859	7.073
19000	36	20.314	6.741
20000	16	16.827	7.613
21000	27	19.424	7.590
22000	20	16.751	8.324
23000	14	17.909	9.812
24000	20	18.772	6.947
25000	22	16.087	8.068
26000	24	16.572	8.766
27000	30	16.671	8.760
28000	79	18.134	8.090
29000	90	17.401	7.508
31000	229	16.598	8.198
33000	245	16.688	8.544
35000	192	15.987	7.923
37000	93	16.979	7.915
39000	45	16.302	7.887
41000	37	16.642	8.081
43000	1	29.224	0.000
45000	0	0.000	0.000
Total	1469		

Table 24: Statistics on Aircraft Encounters by Altitude for Hour 1

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	1	13.687	0.000
4000	1	6.603	0.000
5000	5	17.435	6.983
6000	4	21.184	8.238
7000	2	20.857	5.312
8000	2	14.574	4.109
9000	3	21.181	6.629
10000	2	22.373	0.399
11000	2	20.102	12.935
12000	0	0.000	0.000
13000	3	25.212	3.108
14000	5	16.168	7.822
15000	1	16.412	0.000
16000	11	16.712	8.187
17000	15	18.088	7.183
18000	6	15.195	4.920
19000	9	17.952	6.937
20000	4	17.507	9.400
21000	5	21.100	5.289
22000	4	22.683	3.967
23000	5	19.650	9.864
24000	9	14.909	5.550
25000	5	13.349	9.296
26000	7	15.178	9.820
27000	2	18.960	9.926
28000	29	19.095	8.754
29000	32	17.248	8.530
31000	85	16.460	8.063
33000	72	17.023	8.577
35000	55	15.810	8.413
37000	16	16.878	8.424
39000	1	14.150	0.000
41000	11	14.283	8.543
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	414		

Table 25: Statistics on Aircraft Encounters by Altitude for Hour 2

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	1	6.907	0.000
4000	1	14.262	0.000
5000	4	16.885	11.733
6000	6	18.808	6.867
7000	3	10.754	6.949
8000	1	16.982	0.000
9000	0	0.000	0.000
10000	3	8.217	2.061
11000	1	24.632	0.000
12000	2	19.993	7.830
13000	2	16.449	4.125
14000	3	21.068	4.615
15000	2	9.365	8.296
16000	2	14.651	18.906
17000	3	19.575	9.298
18000	3	12.753	10.769
19000	4	18.469	11.482
20000	1	14.496	0.000
21000	7	16.413	9.418
22000	5	13.665	7.887
23000	3	15.347	11.196
24000	4	21.466	6.921
25000	3	17.054	7.521
26000	2	17.245	11.662
27000	7	22.513	7.542
28000	6	18.194	6.877
29000	18	19.339	6.489
31000	40	16.454	7.044
33000	53	14.719	8.542
35000	31	15.473	8.066
37000	9	19.914	6.198
39000	5	19.003	8.227
41000	2	14.522	11.430
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	237		

Table 26: Statistics on Aircraft Encounters by Altitude for Hour 3

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	3	22.504	2.233
5000	0	0.000	0.000
6000	6	19.288	10.574
7000	11	14.711	8.887
8000	7	20.186	6.868
9000	4	19.440	9.977
10000	6	18.862	3.322
11000	8	18.052	7.093
12000	5	16.299	10.574
13000	5	21.192	7.212
14000	1	14.439	0.000
15000	5	23.833	2.661
16000	10	22.441	6.447
17000	8	20.766	4.463
18000	7	17.152	6.912
19000	6	22.572	4.535
20000	4	19.264	6.607
21000	4	19.121	7.375
22000	1	4.833	0.000
23000	3	16.008	13.334
24000	2	18.518	12.177
25000	8	14.842	7.948
26000	4	14.683	6.474
27000	7	16.368	5.574
28000	13	16.151	7.465
29000	17	16.812	6.781
31000	54	18.533	8.163
33000	57	17.225	8.424
35000	31	15.128	8.027
37000	15	16.811	8.681
39000	16	17.355	8.912
41000	7	19.568	7.281
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	335		

Table 27: Statistics on Aircraft Encounters by Altitude for Hour 4

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	0	0.000	0.000
5000	0	0.000	0.000
6000	5	15.928	6.027
7000	3	16.499	7.527
8000	0	0.000	0.000
9000	2	16.527	9.325
10000	5	15.323	8.319
11000	9	12.572	7.746
12000	5	22.853	6.638
13000	5	23.695	4.626
14000	1	20.446	0.000
15000	6	16.248	9.105
16000	4	23.426	3.214
17000	0	0.000	0.000
18000	6	18.600	7.994
19000	13	22.297	5.559
20000	7	15.378	8.441
21000	7	19.390	9.453
22000	7	18.070	9.167
23000	3	19.467	10.079
24000	5	23.671	4.874
25000	6	19.545	8.267
26000	9	19.352	9.085
27000	13	12.382	8.927
28000	26	19.333	7.388
29000	20	16.970	7.501
31000	45	14.859	9.157
33000	50	16.625	8.619
35000	61	16.368	7.725
37000	43	16.881	7.890
39000	23	15.075	7.329
41000	16	17.109	8.302
43000	1	29.224	0.000
45000	0	0.000	0.000
Total	406		

Table 28: Statistics on Aircraft Encounters by Altitude for Hour 5

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	1	26.497	0.000
5000	0	0.000	0.000
6000	3	26.216	4.837
7000	1	18.470	0.000
8000	0	0.000	0.000
9000	0	0.000	0.000
10000	1	26.651	0.000
11000	1	21.312	0.000
12000	0	0.000	0.000
13000	0	0.000	0.000
14000	0	0.000	0.000
15000	0	0.000	0.000
16000	1	8.240	0.000
17000	2	16.851	1.372
18000	2	21.756	7.577
19000	4	17.643	7.346
20000	0	0.000	0.000
21000	4	22.959	2.986
22000	3	14.881	9.036
23000	0	0.000	0.000
24000	0	0.000	0.000
25000	0	0.000	0.000
26000	2	12.047	11.294
27000	1	29.070	0.000
28000	5	11.415	9.338
29000	3	13.613	7.745
31000	5	14.852	9.362
33000	13	20.745	7.847
35000	14	18.055	6.798
37000	10	15.171	8.243
39000	0	0.000	0.000
41000	1	18.874	0.000
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	77		

Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

Table 29: Statistics on Ground Speed by Altitude for All Hours

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	16	143.864	22.629
2000	120	172.485	46.617
3000	303	188.179	51.039
4000	425	186.616	48.186
5000	496	189.860	52.319
6000	532	179.554	47.944
7000	567	192.848	51.200
8000	635	197.444	55.731
9000	638	199.877	55.668
10000	626	231.897	73.955
11000	607	236.276	70.635
12000	601	245.648	75.100
13000	581	261.737	71.469
14000	568	269.669	76.189
15000	567	271.726	71.736
16000	555	271.718	74.475
17000	548	274.931	72.790
18000	536	274.252	79.191
19000	517	310.178	80.669
20000	500	293.916	82.755
21000	476	323.691	70.721
22000	458	337.521	87.756
23000	460	362.566	81.668
24000	469	385.810	74.979
25000	475	386.820	80.676
26000	477	408.304	67.679
27000	493	421.732	82.213
28000	511	426.230	47.498
29000	510	465.807	53.817
31000	503	418.703	41.890
33000	450	469.997	41.961
35000	325	403.100	43.654
37000	233	474.788	54.124
39000	148	404.425	56.166
41000	92	471.722	41.174
43000	35	429.946	47.839
45000	9	469.719	40.544

Table 30: Statistics on Ground Speed by Altitude for Hour 1

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	3	125.467	8.476
2000	24	179.504	51.702
3000	68	179.424	47.446
4000	91	185.334	42.657
5000	109	194.413	47.828
6000	120	177.106	48.029
7000	135	205.584	51.132
8000	164	203.921	49.363
9000	177	207.068	58.174
10000	177	242.699	73.920
11000	174	254.700	65.958
12000	177	250.090	66.430
13000	174	267.946	63.385
14000	175	261.622	63.878
15000	175	271.305	62.413
16000	166	274.151	71.695
17000	162	279.754	67.103
18000	155	282.288	91.986
19000	151	301.999	72.500
20000	147	318.741	78.380
21000	140	326.769	64.250
22000	133	320.407	88.691
23000	134	351.520	68.972
24000	133	368.716	76.897
25000	145	378.619	73.635
26000	147	416.697	53.219
27000	138	430.420	55.437
28000	146	420.900	49.510
29000	145	447.533	57.969
31000	156	414.007	42.907
33000	118	471.556	43.283
35000	91	398.580	42.868
37000	57	467.123	48.994
39000	39	420.675	50.659
41000	23	467.451	50.966
43000	5	376.745	36.233
45000	1	496.231	0.832

Table 31: Statistics on Ground Speed by Altitude for Hour 2

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	2	167.889	14.581
2000	29	163.825	44.245
3000	70	179.721	52.631
4000	99	179.560	48.279
5000	116	179.766	64.403
6000	127	171.049	51.722
7000	129	187.863	48.469
8000	131	190.268	51.456
9000	129	195.110	59.049
10000	130	232.916	78.108
11000	127	224.248	79.067
12000	123	283.465	85.319
13000	114	290.315	76.091
14000	114	305.532	76.653
15000	113	307.841	81.705
16000	111	287.162	75.038
17000	114	277.231	68.981
18000	109	292.634	97.216
19000	108	351.178	70.902
20000	102	309.198	87.780
21000	100	317.171	55.357
22000	98	324.901	90.132
23000	103	367.474	98.793
24000	105	386.630	80.325
25000	108	383.621	97.721
26000	107	369.793	104.309
27000	112	394.287	87.821
28000	122	441.859	44.275
29000	122	467.985	55.957
31000	127	417.800	44.010
33000	111	468.092	42.220
35000	82	400.762	42.839
37000	56	466.472	65.225
39000	34	391.677	77.434
41000	25	474.710	42.243
43000	8	460.315	36.007
45000	1	408.769	2.788
Total	2	167.889	14.581

Table 32: Statistics on Ground Speed by Altitude for Hour 3

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	3	141.769	15.128
2000	22	184.186	59.428
3000	63	196.939	57.622
4000	97	195.420	49.395
5000	115	200.387	49.861
6000	130	185.403	45.211
7000	142	197.801	50.778
8000	161	194.575	56.818
9000	163	196.350	53.595
10000	155	224.793	73.361
11000	150	235.927	67.727
12000	151	253.001	65.118
13000	143	257.858	64.985
14000	138	270.861	77.709
15000	144	262.492	72.760
16000	144	255.706	70.901
17000	138	261.533	85.644
18000	135	264.771	75.123
19000	130	298.499	86.853
20000	125	282.808	86.076
21000	118	346.019	86.795
22000	108	377.214	70.589
23000	109	346.487	67.651
24000	114	397.906	74.951
25000	114	382.846	70.921
26000	110	400.357	66.605
27000	123	438.599	65.365
28000	129	419.620	55.069
29000	130	475.252	45.630
31000	129	418.510	42.813
33000	128	473.884	42.667
35000	97	407.418	46.453
37000	67	477.536	56.402
39000	38	389.752	51.289
41000	32	466.378	39.742
43000	10	453.050	48.532
45000	4	444.195	27.168

Table 33: Statistics on Ground Speed by Altitude for Hour 4

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	5	162.500	10.399
2000	35	169.749	40.455
3000	89	199.675	44.342
4000	122	193.563	48.538
5000	139	195.473	47.792
6000	154	183.882	44.776
7000	164	189.141	50.308
8000	177	207.395	61.521
9000	169	208.025	52.498
10000	164	235.366	69.853
11000	155	236.090	66.359
12000	149	228.769	76.175
13000	140	246.892	72.518
14000	133	257.533	81.806
15000	129	264.042	71.593
16000	130	282.089	76.847
17000	126	292.304	74.371
18000	130	272.269	64.095
19000	121	313.350	78.882
20000	123	277.551	73.457
21000	113	319.728	70.319
22000	110	337.999	88.574
23000	110	375.633	80.802
24000	118	381.029	73.859
25000	113	399.523	79.371
26000	115	414.691	54.287
27000	128	433.606	81.915
28000	131	427.205	40.688
29000	141	468.630	50.266
31000	140	422.856	38.266
33000	128	464.903	41.767
35000	97	402.956	41.900
37000	92	477.516	48.496
39000	60	410.030	47.468
41000	38	478.150	30.727
43000	16	417.836	46.241
45000	5	469.801	36.722

Table 34: Statistics on Ground Speed by Altitude for Hour 5

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	3	121.273	19.494
2000	12	170.459	32.617
3000	23	183.245	56.550
4000	39	165.286	49.113
5000	50	165.213	43.797
6000	53	170.077	53.759
7000	53	168.209	49.682
8000	61	182.647	46.195
9000	52	187.000	52.551
10000	45	214.600	74.335
11000	43	223.627	68.788
12000	38	213.313	85.511
13000	35	256.344	96.500
14000	35	295.849	83.031
15000	38	281.188	70.896
16000	35	280.333	83.520
17000	38	252.930	58.966
18000	37	267.527	69.501
19000	36	298.781	79.577
20000	35	303.182	80.931
21000	34	303.479	76.947
22000	29	369.668	67.582
23000	28	420.682	60.189
24000	28	416.487	40.277
25000	28	448.596	84.211
26000	33	432.786	46.072
27000	39	401.038	111.430
28000	38	423.193	40.281
29000	38	497.125	33.935
31000	46	429.021	36.767
33000	60	473.812	33.573
35000	50	417.987	43.527
37000	44	486.805	46.579
39000	18	423.085	40.242
41000	15	468.773	43.592
43000	9	423.638	31.249
45000	2	510.765	12.488

Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

Table 35: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	6	9
	DES	0	2
	LEV	3	10
2000	ASC	35	42
	DES	36	26
	LEV	53	67
3000	ASC	111	132
	DES	93	97
	LEV	159	138
4000	ASC	109	84
	DES	128	108
	LEV	250	146
5000	ASC	135	70
	DES	156	96
	LEV	307	125
6000	ASC	122	90
	DES	181	97
	LEV	337	103
7000	ASC	127	68
	DES	203	76
	LEV	335	106
8000	ASC	114	56
	DES	280	153
	LEV	341	87
9000	ASC	60	36
	DES	294	172
	LEV	332	64
10000	ASC	122	47
	DES	296	138
	LEV	334	74
11000	ASC	82	30
	DES	321	71
	LEV	316	63
12000	ASC	76	27
	DES	323	48
	LEV	312	34
13000	ASC	35	10
	DES	314	34
	LEV	307	29

14000	ASC	35	18
	DES	313	35
	LEV	307	31
15000	ASC	41	29
	DES	311	37
	LEV	307	34
16000	ASC	50	27
	DES	294	29
	LEV	298	26
17000	ASC	50	30
	DES	289	27
	LEV	293	35
18000	ASC	45	20
	DES	280	17
	LEV	292	31
19000	ASC	46	27
	DES	276	18
	LEV	280	33
20000	ASC	43	24
	DES	260	18
	LEV	269	46
21000	ASC	39	22
	DES	247	16
	LEV	258	36
22000	ASC	45	24
	DES	239	18
	LEV	247	30
23000	ASC	49	30
	DES	245	21
	LEV	241	43
24000	ASC	83	41
	DES	237	32
	LEV	242	45
25000	ASC	60	29
	DES	233	28
	LEV	263	48
26000	ASC	56	30
	DES	239	27
	LEV	273	50
27000	ASC	83	46
	DES	247	40
	LEV	285	50
28000	ASC	179	99
	DES	244	39

	LEV	307	49
29000	ASC	190	100
	DES	247	32
	LEV	298	44
31000	ASC	245	131
	DES	242	38
	LEV	299	54
33000	ASC	265	172
	DES	211	47
	LEV	237	37
35000	ASC	219	135
	DES	141	26
	LEV	152	30
37000	ASC	167	119
	DES	113	27
	LEV	91	19
39000	ASC	103	56
	DES	77	13
	LEV	49	15
41000	ASC	81	50
	DES	51	16
	LEV	31	10
43000	ASC	31	17
	DES	15	2
	LEV	9	1
45000	ASC	8	4
	DES	4	1
	LEV	4	1

Appendix D: Supplement to Section 7.2 - Aircraft Models

Table 36: Count and Percentage of Aircraft by Model Type

Model Type	Aircraft Count	Percent of Total
MD80	149	9.701
B733	79	5.143
DC9Q	68	4.427
B722	58	3.776
SF34	57	3.711
B752	52	3.385
BE20	39	2.539
B735	38	2.474
DC9	38	2.474
BE58	35	2.279
CARJ	35	2.279
B72Q	34	2.214
F100	32	2.083
BE9L	26	1.693
A320	24	1.563
B732	24	1.563
B73Q	24	1.563
B737	23	1.497
B763	18	1.172
LJ35	18	1.172
E145	17	1.107
C130	16	1.042
C210	16	1.042
BE40	14	0.911
C421	14	0.911
C560	14	0.911
E120	14	0.911
FA20	14	0.911
PA31	14	0.911
BE36	13	0.846
H25B	13	0.846
B190	12	0.781
DC10	12	0.781
JS32	12	0.781
BE30	11	0.716
C650	11	0.716
T38	11	0.716
A306	10	0.651
BE35	10	0.651

LJ24	9	0.586
MU2	9	0.586
B734	8	0.521
B762	8	0.521
C340	8	0.521
C550	8	0.521
GLF4	8	0.521
LJ31	8	0.521
C500	7	0.456
JS41	7	0.456
L101	7	0.456
LJ60	7	0.456
AC90	6	0.391
AT45	6	0.391
M20	6	0.391
PA32	6	0.391
PA34	6	0.391
B772	5	0.326
GLF2	5	0.326
LJ55	5	0.326
PAY2	5	0.326
PC12	5	0.326
SBR1	5	0.326
A319	4	0.260
C182	4	0.260
H25A	4	0.260
LJ25	4	0.260
MD90	4	0.260
PAY1	4	0.260
WW24	4	0.260
AEST	3	0.195
BE10	3	0.195
C141	3	0.195
C177	3	0.195
C501	3	0.195
DC87	3	0.195
GLF3	3	0.195
H60	3	0.195
HS25	3	0.195
JS31	3	0.195
P31T	3	0.195
P32R	3	0.195
PA24	3	0.195
PA27	3	0.195
PA46	3	0.195

PAY3	3	0.195
SW3	3	0.195
A124	2	0.130
A310	2	0.130
A340	2	0.130
AC69	2	0.130
AC6T	2	0.130
AC95	2	0.130
ASTR	2	0.130
AT72	2	0.130
B52	2	0.130
B721	2	0.130
B727	2	0.130
B744	2	0.130
BE33	2	0.130
BE60	2	0.130
BE99	2	0.130
C172	2	0.130
C414	2	0.130
C750	2	0.130
CL65	2	0.130
DC86	2	0.130
E6	2	0.130
F16	2	0.130
F2TH	2	0.130
FA50	2	0.130
GC1	2	0.130
H25C	2	0.130
KR35	2	0.130
LR35	2	0.130
MD11	2	0.130
MXT7	2	0.130
P210	2	0.130
P28R	2	0.130
P3	2	0.130
PA28	2	0.130
SH33	2	0.130
SW4	2	0.130
T37	2	0.130
A10	1	0.065
AC11	1	0.065
AC70	1	0.065
AC9T	1	0.065
AT38	1	0.065
AT43	1	0.065

B2	1	0.065
B350	1	0.065
B55	1	0.065
B738	1	0.065
B742	1	0.065
BE18	1	0.065
BE65	1	0.065
BE76	1	0.065
BE90	1	0.065
BE95	1	0.065
BL17	1	0.065
C12	1	0.065
C135	1	0.065
C180	1	0.065
C185	1	0.065
C208	1	0.065
C335	1	0.065
C337	1	0.065
C401	1	0.065
C402	1	0.065
C425	1	0.065
C441	1	0.065
CL41	1	0.065
DC8	1	0.065
DC8Q	1	0.065
F900	1	0.065
FA90	1	0.065
G2	1	0.065
G4	1	0.065
GLF5	1	0.065
L29B	1	0.065
L329	1	0.065
LJ23	1	0.065
LJ45	1	0.065
LR24	1	0.065
LR25	1	0.065
M20P	1	0.065
M20T	1	0.065
MO20	1	0.065
MU2B	1	0.065
MU30	1	0.065
P180	1	0.065
PA23	1	0.065
PA30	1	0.065
PA44	1	0.065

SW2	1	0.065
T2	1	0.065
TRIN	1	0.065
Total	1536	100.000